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COMPLEMENTARY COLORS AND CONSUMER BEHAVIOR: EMOTIONAL AFFECT,
ATTITUDE, AND PURCHASE INTENTION IN THE CONTEXT OF WEB BANNER
ADVERTISEMENTS

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Abstract

The purpose of this paper is to study how color contrast (complementary vs. analogous colors) affect individuals' emotions and attitudes towards advertisements and purchase intention in the context of online web banner advertisements. Our study found that the complementary color pair of green and red elicited statistically higher levels of pleasure than all other color sets (yellow-violet complementary; orange, orange-red, orange-yellow analogous; and blue, blue-green, blue-violet analogous). Furthermore, the green and red complementary color set had more positive attitudes and higher purchase intentions when used as the background of a web banner advertisement than all over color sets.

Keywords: Marketing, Colors, Consumer Behavior, Psychology

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Introduction

Many studies have been done on color in relation to psychology, consumer behavior, and marketing. In psychology, color has been studied in the context of how it can affect individuals' emotions and mood (Valdez and Mehrabian 1994; Wexner 1954). In addition to color affecting emotions and mood, it can also cause individuals to perceive colors as having personalities or tangible attributes, such as how blue-green might remind someone of the sea and thus the feeling of relaxation, or how yellow-green might remind someone of vomit and thus the feeling of disgust (Kaya and Epps 2004). In relation to color and consumer behavior, color is known to cause emotional reactions and mood changes within individuals in a variety of different environments, such as in physical shopping environments (Babin et al 2003), and in online shopping environments (Biers and Richard 2005). These emotional effects in shopping environments can also affect individuals' attitude and purchase intention towards products, thus helping to influence their behavior. Regarding color and marketing, 90% of fast decisions about products are based on the color of the products alone (Gopikrishna and Kumar 2015). This idea that colors can affect purchase intention and product/brand perception

was studied in Labrecque and Milne (2012), where they found that hue and saturation of logos and packaging can affect brand perception and purchase intention.

While research has been done on color in these contexts, research is lacking on how complementary colors affect emotions and consumer behavior. Typically, the research done on colors focused on individual colors or colors in the same hue family (i.e. warm colors or cool colors). Since complementary colors are “opposites” on the color wheel and create a neutral color when mixed, the effects of colors when shown in conjunction with one another need to be studied more extensively in order to determine if they produce a neutral emotional response or a response more in line with the emotional effect that each individual color would produce.

The aim of this paper is twofold: to do an empirical study on complementary colors vs. analogous colors and how they affect individuals’ emotions, and how complementary colors vs. analogous colors affect attitude and purchase intention in the context of a web banner advertisement.

Complementary Colors

One simple definition of complementary colors is that they are any two opposing colors, meaning they lie directly opposite from each other on the color wheel. However, complementary colors can be broken down into three different types: subtractive complements, optical complements, and afterimage complements. Subtractive complements are two colors that when combined create a grey or neutral color, such as green and red or yellow and violet. Optical complements are two colors that when combined using additive color mixing become grey or neutral, such as yellow and blue. Afterimage complements are when one color is stared at and upon looking away from the color produces an after image in one’s vision of its complementary color (Westland et al. 2007). This theory of complementary colors as opposing colors was studied by Jameson and Hurvich (1955) in a series of papers on

hue cancellation. In this study, participants were given a series of different hued lights and asked to cancel the hue out by adding a test light of a different hue to it. In this experiment they found that a green hued light could be added to a red hued light to cancel out the red and produce a neutral colored light (Wandell 1995).

Although complementary colors when added to one another cancel each other out, they are often placed together to make the other color stand out more. This phenomenon was noted by Michael Eugene Chevreul in his book “The Principles of Harmony and Contrast of Colors and Their Applications to the Arts” where he described how two complementary colors will appear “as dissimilar as possible” when placed next to one another. This observation contrasts with non-complementary colors that will often take on a similar hue to the color next to it (Chevreul 1855). The use of complementary color to make colors more conspicuous can be seen with the use of orange life vests and orange life boats in blue water to attract attention to rescuers, or the use of green walls in butcher shops to make the meat appear more red (Blaszczyk 2012). Some 3-D glasses also take advantage of complementary colors by using one cyan lens and one red lens. Each lens feeds a unique image into each eye. The brain then combines the images together to form one 3D image.

Analogous Colors

In color theory, analogous colors are a group of three colors located next to each other on the color wheel. There is a dominant color, which is typically a primary color, a second color that acts as a support, and a third that is used as an accent. An example of this pairing would be blue, blue-green, and blue-violet. Analogous colors are inherently harmonious because of their close relationship to each other on the color wheel. Thus, their respective hues only vary slightly. Analogous colors can often be seen in nature such as leaves changing from yellow to orange to red in the fall or in the sea merging into shades of blue and blue

green. Conversely to complementary colors, when analogous colors are viewed together, they will take on the hue of the color directly adjacent and appear similar in color.

Literature Review

PAD Scale

In order to categorize the emotional effect associated with the color sets in this study, we will use the Pleasure-Arousal-Dominance Emotional Model. This model is used in many studies on the emotional effect of color on emotions including Valdez and Mehrabian (1994) and is proven to be a valid indicator of emotional states caused by colors. The model is based on the theory that emotional states include three bipolar dimensions: pleasure, arousal, and dominance. Pleasure/displeasure is how happy or unhappy something causes a person to feel. Arousal is how stimulating something is to an individual. Dominance/submissiveness is how in control or out of control something makes an individual feel (Porant and Tractinsky 2012).

Colors and Emotional Affect

The theory that color can be associated with an emotional affect or mood has been studied quite extensively in various contexts. In a 1954 study, Lois B. Wexner found that some colors are more often associated with a specific mood tone, such as red is often “exciting and stimulating”, blue is more often “secure, comfortable, tender and soothing”, yellow is “cheerful, jovial, and joyful”, and purple is “dignified and stately” (Wexner 1954). When applying the PAD model to this study, we can surmise that red shows high levels of arousal and pleasure, blue shows high levels of pleasure and low levels of arousal, yellow shows high levels of pleasure, and purple shows high levels of dominance.

In Valdez and Mehrabian’s (1994) study on the effect of colors on emotion, they found that blue, blue-green, and green all had higher levels of pleasure, while yellow had the lowest level of pleasure. Regarding arousal levels, green-yellow had the highest levels followed by blue-green and green. Yellow-red, purple-blue, and red-purple all had lower

levels of arousal, while blue, yellow, red, and purple all had levels somewhere in the middle. Lastly, green-yellow and yellow had the highest levels of dominance and red-purple had the lowest levels. Blue, blue-green, purple, purple-blue, yellow-red, and red all fell more in the middle (Valdez and Mehrabian 1994).

A study on college student's emotional reactions to color found that primary colors (red, yellow, green, blue, purple, etc.) elicited the largest number of positive responses at 79.6%, followed by intermediate hues (yellow-red, green-blue etc.) with 64.5% positive responses, and finally achromatic colors (white, gray, and black) with 29.2% positive responses. The study also found that colors can cause an emotional response, because they can remind the person of something tangible. For example, blue is calming and serene because it reminds one of the ocean or sky, and green symbolizes hope and peace because its associated with nature and grass (Kaya and Epps 2004).

Colors and Marketing

Color plays an integral role in the consumer decision making process, especially when a consumer must evaluate a product quickly. Up to 90% of quick evaluations made by consumers on products are solely based on color (Gopikrishna and Kumar 2015). In the Labrecque and Milne (2012) study, this theory of evaluations based on color alone was supported. In the study, participants were presented with identical logos in several hues and asked to rate their perceptions of each logo's brand. Their study concluded that color could influence one's perception of a brand, causing them to rate the "sincerity, ruggedness, excitement, competence, and sophistication" of a brand based on logo color alone. Furthermore, it was found that hue and saturation levels could affect individuals' purchase intentions due to their association with a brand's personality. If the hue and saturation levels of a brand's packaging were associated with a more preferred perception of the brand

(ruggedness), then the purchase intent of that brand's product was higher than if it was associated with a less preferred perception (sophistication) (Labrecque and Milne 2012).

In addition to certain colors causing specific emotional responses and personality perceptions, groups of colors can cause emotional reactions and affect decision making as well. In Babin et al (2003) it was found that when participants were subjected to different store interiors, they reacted more favorably to cool toned store environments. The participants rated the color blue as more favorable and likeable and had higher purchase intentions compared to the warm toned (orange) shopping environment (Babin et al 2003). The preference for cool toned colors is seen not only in relation to store interiors, but in several other studies as well. In the Biers and Richards (2005) study on background color's effect on product choice in an e-commerce environment, they found that warm colors, such as red, yellow, and orange, delayed consumers' purchase intention when high priced items were featured on those backgrounds. In contrast, cool backgrounds (blue and purple) evoked higher levels of purchase intention with high priced items. Furthermore, the study also found that attitude towards a product was directly correlated with purchase intention. The higher the perception of attractiveness of that product, the higher the purchase intention (Biers and Richard 2005).

Emotions and Marketing

Emotions play a strong role in consumer behavior and decision making. Emotions and mood have a strong effect on consumer evaluations, in particular. People who are in a positive mood have the tendency to evaluate products more positively than if they were in a negative or neutral mood (Isen et al 1978; Srull 1983). In Isen et al.'s (1978) study, participants rated their cars and televisions more favorably when they were in a positive mood, instead of a negative or neutral mood (Bagozzi et al 1999). The feelings as information model proposed in Schwarz (1990), Schwarz and Bless (1991), and Schwarz and Clore (1983), theorizes that

people who are in a positive mood may attribute their positive mood to what they are evaluating as having caused the positive mood. Clore et. al (1994) proposed that people may use the feelings as information model when the evaluation is inherently affective, when there is not enough other information or it's complex, or they don't have enough time to evaluate (Bagozzi et al 1999).

This feelings as information model is also supported in Ruth's (2001) paper on the influence of emotion categorization process on consumer evaluations. This study found that emotions in brand advertising influence brand attitudes in two ways: they can provoke feelings in individuals and through knowledge can cause an individual to think about the positive emotional benefits of using the brand (Ruth 2001). The study also showed that consumers can perceive a difference in brands purely based on the emotional benefits associated with that brand (Ruth 2001).

Attitude and Purchase Intention

Attitude towards advertisements/brands has been studied in a number of different studies. One such study was in Lutz et. al (1983), which explored a model that depicted how an exposure to an advertisement created ad cognitions and brand cognitions. Ad cognitions were found to affect attitude towards the ad which then affects purchase intention, independent of brand attitude. However, there are a multitude of variables that affect attitude towards the ad. In the McKenzie and Lutz (1989) study, ad credibility, ad perceptions, attitude towards advertiser, attitude towards advertising, and mood all affected attitude towards the ad.

Hypotheses Formulation

Although color has begun to be studied more extensively in the realms of consumer behavior, psychology, and marketing, studies on complementary colors and their effects on the consumer psyche are lacking. The aim of our research is to answer two research questions: (1) how will complementary colors vs. analogous colors affect individuals' emotions; and (2)

how will complementary colors vs. analogous colors affect individuals' attitudes and purchase intention in the context of web banner advertisements. We hypothesize that complementary colors, instead of creating a neutral emotional effect, will have an emotional effect consistent with each color present in the complementary color set. This hypothesis is based off Michael Eugene Chevreul 1854's work on color theory, and the notion that complementary colors only make each color stand out more, rather than neutralizing their effect. The emotional affect levels will be based on the emotional effect of the colors found in Valdez and Mehrabian (1994).

H1a: Yellow and violet complementary color set will have lower levels of pleasure than the red and green complementary color set.

H1b: Yellow and violet complementary color set will have lower levels of arousal than the red and green complementary color set.

H1c: Yellow and violet complementary color set will have higher levels of dominance than the red and green complementary color set.

For the analogous color sets, our hypotheses will be consistent with the previous research done on favorability of cool colors over warm colors. As described in the studies of Babin et al (2003) and Biers and Richards (2005), we predict that the blue hued (cool) analogous color set will have higher levels of pleasure, arousal, and dominance than the complementary color sets and the orange hued (warm) analogous color set. Also, that the orange analogous color set will have lower levels of pleasure, arousal, and dominance than the complementary color sets and the blue hued (cool) analogous color set.

H2a: Blue hued (cool) analogous color set will have higher levels of pleasure than all other color sets (complementary and analogous).

H2b: Blue hued (cool) analogous color set will have higher levels of arousal than all other color sets.

H2c: Blue hued (cool) analogous color set will have higher levels of dominance than all other color sets.

H3a: Orange hued (warm) analogous color set will have lower levels of pleasure than all other color sets.

H3b: Orange hued (warm) analogous color set will have lower levels of arousal than all other color sets.

H3c: Orange hued (warm) analogous color set will have lower levels of dominance than all other color sets (complementary and analogous).

For our second research question on how complementary colors vs. analogous colors will affect attitudes towards the advertisements and purchase intention, we are basing our hypotheses on how color's emotional effect will affect consumer's attitude and purchase intentions on several studies. Firstly, we can hypothesize that color will affect attitude and purchase intention (Biers and Richard 2005). Furthermore, emotions caused by those colors can influence consumers' attitudes about a product (Isen et al. 1978; Srull 1983; Ruth 200; Bagozzi et al. 1999; Schwarz 1990; Schwarz and Bless 1991; and Schwarz and Clore 1983). More pleasurable colors will cause more positive attitudes towards advertisements, and thus have higher purchase intentions.

H4: Advertisements with color sets that have higher levels of pleasure, arousal, and dominance will cause consumers to have a more favorable attitude towards a product.

H5: Advertisements with color sets that have higher levels of pleasure, arousal, and dominance will cause consumers to have higher purchase intentions towards a product.

We developed two studies to test our predictions.

Study 1

In Study 1, we examine whether complementary colors (vs. analogous colors) will elicit levels of pleasure, arousal, and dominance consistent with levels that the colors produce singularly or will produce a neutral emotional effect.

Procedure and Variables

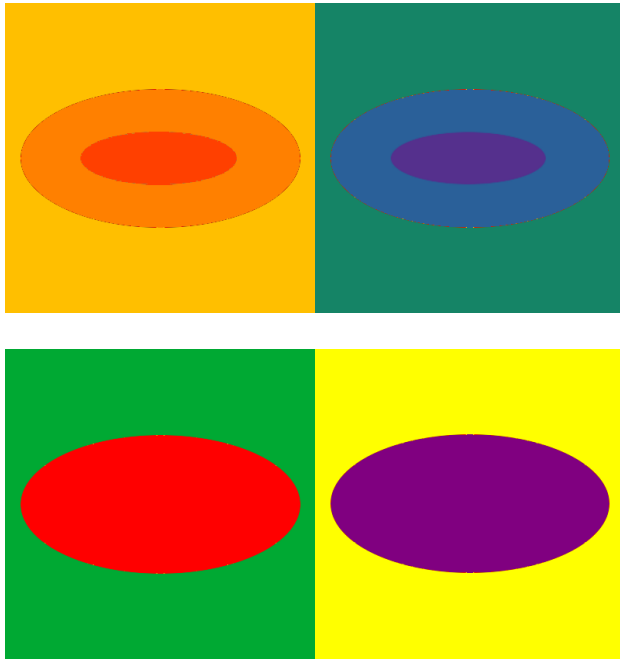
The study was conducted using a survey on Qualtrics. The survey was dispersed via Facebook in order to receive responses from a variety of nationalities and age groups. Participants ($n = 182$) were first presented with 14 Ishihara plates to test for colorblindness and were asked to type the number that they saw appear on each plate. Any participant that incorrectly answered 3 or more of the numbers were excluded from the results. Participants were then asked demographic questions to ascertain their age, education level, and nationality. After answering the demographic questions, participants were shown the first of four different color sets that were created using Gimp (Figure 1). The color sets were 2 complementary color sets (yellow and violet/red and green) and 2 analogous color sets (orange analogous and blue analogous). The orange analogous color set consisted of orange, orange-yellow, and orange-red. While the blue analogous color set consisted of blue, blue-violet, and blue-green. We decided to use 3 colors for our analogous color sets, as opposed to using only 2 like in our complementary color sets, because generally analogous colors consist of at least 3 colors in the same hue family. The complementary colors and analogous colors were chosen using the RYB color model. Since the software we used to make the color sets was based on the RGB model, we used an RYB color converter to find the hex codes for the colors used in our color sets. The color converter allowed us to find the colors that were directly across from each other on the RYB color wheel for the complementary color sets, and directly next to each other on the RYB color wheel for the analogous color sets (<https://bahamas10.github.io/ryb/about.html>). After each color set, participants were asked to

rate their emotional state according to a 7-point bipolar scale based off of the PAD scale. The PAD scale is made up of 18 bipolar word pairs, with every 6-word pairs matching to one emotional state: pleasure, arousal, and dominance (Holbrook and Batra 1987; Mehrabian 1995). The word pairs for pleasure are: happy and unhappy, pleased and annoyed, satisfied and unsatisfied, contented and melancholic, hopeful and despairing, and relaxed and bored. The word pairs for arousal are: stimulated and relaxed, excited and calm, frenzied and sluggish, jittery and dull, wide-awake and sleepy, and aroused and unaroused. Lastly, the word pairs for dominance are: controlling and controlled, influential and influenced, in control and cared for, important and awed, dominant and submissive, and autonomous and guided. The word pairs were presented in a random order to prevent participants from guessing the relation of the word pairs. After responding to their emotional affect for each color set, the survey concluded.

In total, 182 participants completed the survey. However, 6 participants were colorblind, and thus excluded from the study. 8% of the men surveyed were colorblind, which is consistent with the percentage of men thought to be colorblind in the entire population. Of the participants surveyed, 34.6% were men and 65.4% were women. Participants came from 25 different countries, with the majorities being from the United States (50.5%), Estonia (20.9%), and Portugal (5.5%). Participants ranged in age from 16 years old to 97 years old, with the largest majority being between the ages of 22 -26 (33%). Most participants had some form of higher education with 43% holding a bachelor's degree, 25.7% holding a master's degree, and 4.3% holding a PhD or other Professional Degree.

Figure 1 – Complementary and Analogous Color Sets

From left to right, top to bottom: orange analogous color set, blue analogous color set, red and green complementary color set, yellow and violet complementary color set



Results and Discussion

In preparing the data for analysis, all incomplete responses and responses by participants who answered 3 or more questions incorrectly during the colorblindness test were excluded. The word pairs corresponding to each category of pleasure, arousal, and dominance were then averaged for each color set of each participant's response to obtain the means for arousal, pleasure, and dominance for each color set. We then used a Multivariate Analysis of Variance to determine significance levels between each group. The MANOVA presented a significance level of .000 when $\alpha = .05$, meaning we can reject the null hypothesis that all the color sets produce the same levels of pleasure, arousal, dominance.

After conducting a Tukey HSD post hoc analysis, it was found that feelings of pleasure were higher when viewing the yellow and violet complementary color set vs. the orange analogous color set ($p = .048$, mean difference = .3149). Feelings of pleasure were also higher when viewing the red and green complementary color set vs. the yellow and violet complementary color set ($p = .001$, mean difference = .4786), vs. the orange analogous color set ($p = .000$, mean difference = .7936), and vs. the blue analogous color set ($p = .044$, mean difference = .3191). Lastly, the blue analogous color set vs. the orange analogous color set (p

= .001, mean difference = .4744) also produced higher levels of pleasure upon viewing. Since the red and green complementary set had higher levels of pleasure than all other color sets, we accept H1a. However, the blue analogous color set only had higher levels of pleasure than the orange analogous color set, which had lower levels of pleasure than all other color sets. We reject H2a and accept H3a.

Arousal levels were higher when viewing the orange analogous color set vs. the yellow and violet color set ($p = .000$, mean difference = .8229) and vs. the red and green complementary color set ($p = .000$, mean difference = .8419). They were also higher when viewing the blue analogous color set vs. the yellow and violet complementary color set ($p = .000$, mean difference = 1.7443), vs. the orange analogous color set ($p = .000$, mean difference = .9214), and vs. the red and green complementary color set ($p = .000$, mean difference = 1.7633). There was no statistically significant difference in means when comparing the arousal levels of the red and green complementary color set and the yellow and violet complementary set, therefore we reject H1b. The blue analogous color set had higher levels of arousal than all other color sets, therefore we confirm H2b. The orange analogous color set did not have lower levels of arousal compared to all other color sets. We reject H3b.

Dominance levels were higher when viewing the yellow and violet complementary color set vs. the red and green complementary color set ($p = .014$, mean difference = .3059). They were also higher when viewing the orange analogous color set vs. the yellow and violet complementary color set ($p = .000$, mean difference = .6534) and vs. the red and green complementary color set ($p = .000$, mean difference = .9593). Finally, dominance levels were also higher when viewing the blue analogous color set vs. the yellow and violet complementary color set ($p = .000$, mean difference = 1.1894), vs the orange analogous color set ($p = .000$, mean difference = .5360), and vs. the red and green complementary color set ($p = .000$, mean difference = 1.4953). The yellow and violet complementary color set had higher

levels of dominance than the red and green complementary set, so we accept H1c. Orange analogous did not have lower levels of dominance than all other color sets, therefore we reject H3c. Finally, the blue analogous color set had higher levels of dominance than all other color sets, therefore, we confirm H2c.

Figure 2a – Estimated Marginal Means of Pleasure Levels for Each Color Set

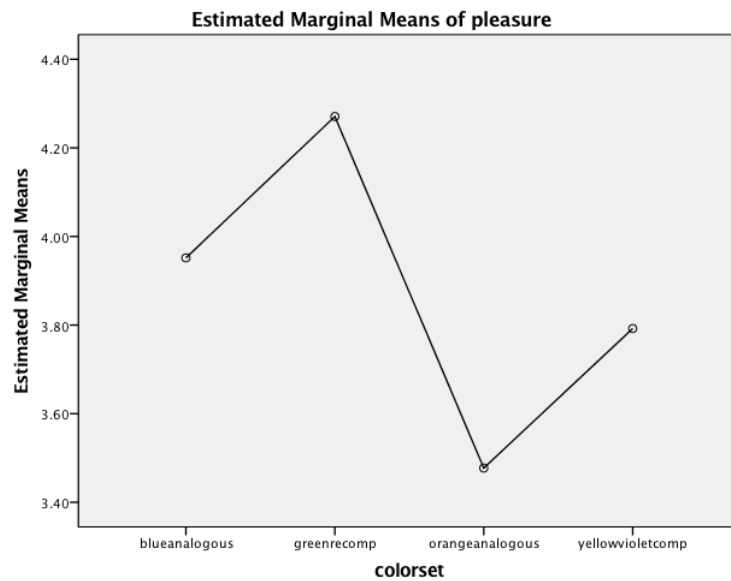


Figure 2b – Estimated Marginal Means of Arousal Levels for Each Color Set

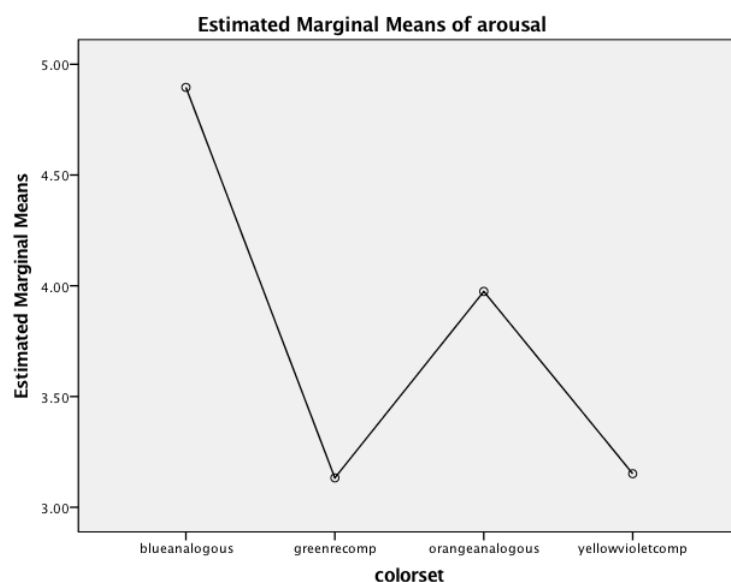
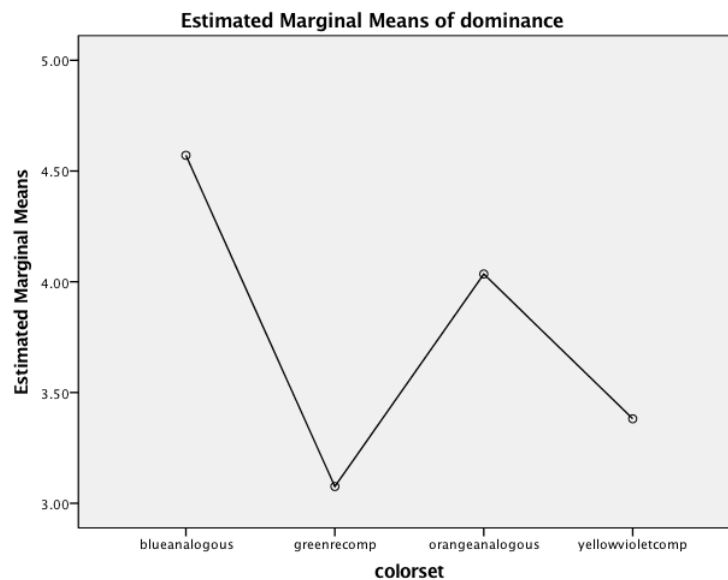


Figure 2c – Estimated Marginal Means of Dominance Levels for Each Color Set



From the analysis, we found that the red and green complementary color set had higher levels of pleasure than all other color sets, but the yellow and violet complementary color set only had higher levels of pleasure compared to the orange analogous color set. One possible explanation for the higher levels of pleasure when viewing the red and green complementary set could be explained by Tergwot and Hoeksma's study (1995) on color preferences that found that the favorite colors of adults are blue, followed by red and green. Yellow is one of the least preferred which could contribute to why its pleasure scores were the lowest of the 4 sets. These results are also consistent with Valdez and Mehrabian's (1994) study on emotional responses to color that found that yellow had the lowest levels of pleasure. Furthermore, the blue analogous color set had higher levels of pleasure compared to the orange analogous color set, however it did not have higher levels of pleasure compared to the red and green complementary set or the yellow and violet complementary set. These results are consistent with Babin et al (2003) and Biers and Richards (2005) that found that blue and cool toned colors have higher levels of pleasure than orange and warm toned colors. The orange analogous color set had lower levels of pleasure than all other color sets.

Our analysis found that the blue analogous color set had higher levels of arousal than all other color sets, which is supported by Babin et al (2003) and Biers and Richards (2005). While the blue analogous color set did contain blue-green, which had high levels of arousal in Valdez and Mehrabian (1994), our results somewhat contradict their study because they found that blue only had average levels of arousal. One possible explanation for this is that the blue-green color in the blue analogous color set made the color set have higher levels of arousal over all, making up for the other colors' lower arousal levels.

Regarding dominance levels, the yellow and violet complementary color set having higher levels of dominance than the red and green complementary set is an interesting discovery. In Valdez and Mehrabian's (1994) study, yellow had the highest levels of dominance, but purple had an average level of dominance. One plausible explanation is that, like the blue analogous color set having higher levels of arousal, the high levels of dominance found in yellow increased the dominance levels for the yellow and violet color set overall. Wexner's (1954) study also supports violet having higher dominance levels, when applying the PAD model to the study's findings. Furthermore, the orange analogous color set not having lower levels of dominance than all other color sets could be explained by its similarity to the yellow hue, which has high levels of dominance in Valdez and Mehrabian's (1994) study.

Study 2

The aim of the second study is to find out how complementary colors vs. analogous colors will affect attitude and purchase intention in the context of web banner advertisements

Procedure and Variables

Similar to the first study, the second study was also conducted by dispersing an online survey made in Qualtrics to peers on Facebook in order to receive a diverse sample of nationalities and age groups. Each participant ($n = 174$) was given a test for colorblindness at

the beginning of the survey consisting of 14 Ishihara plates. Each participant was asked to write the number they saw. Any participant that answered 3 or more of the questions incorrectly was considered colorblind, and thus excluded from our analysis. 12 of our participants were colorblind. 13.3% of males and 2% of females surveyed were colorblind, which is significantly higher than average (8% for males and .05% for females).

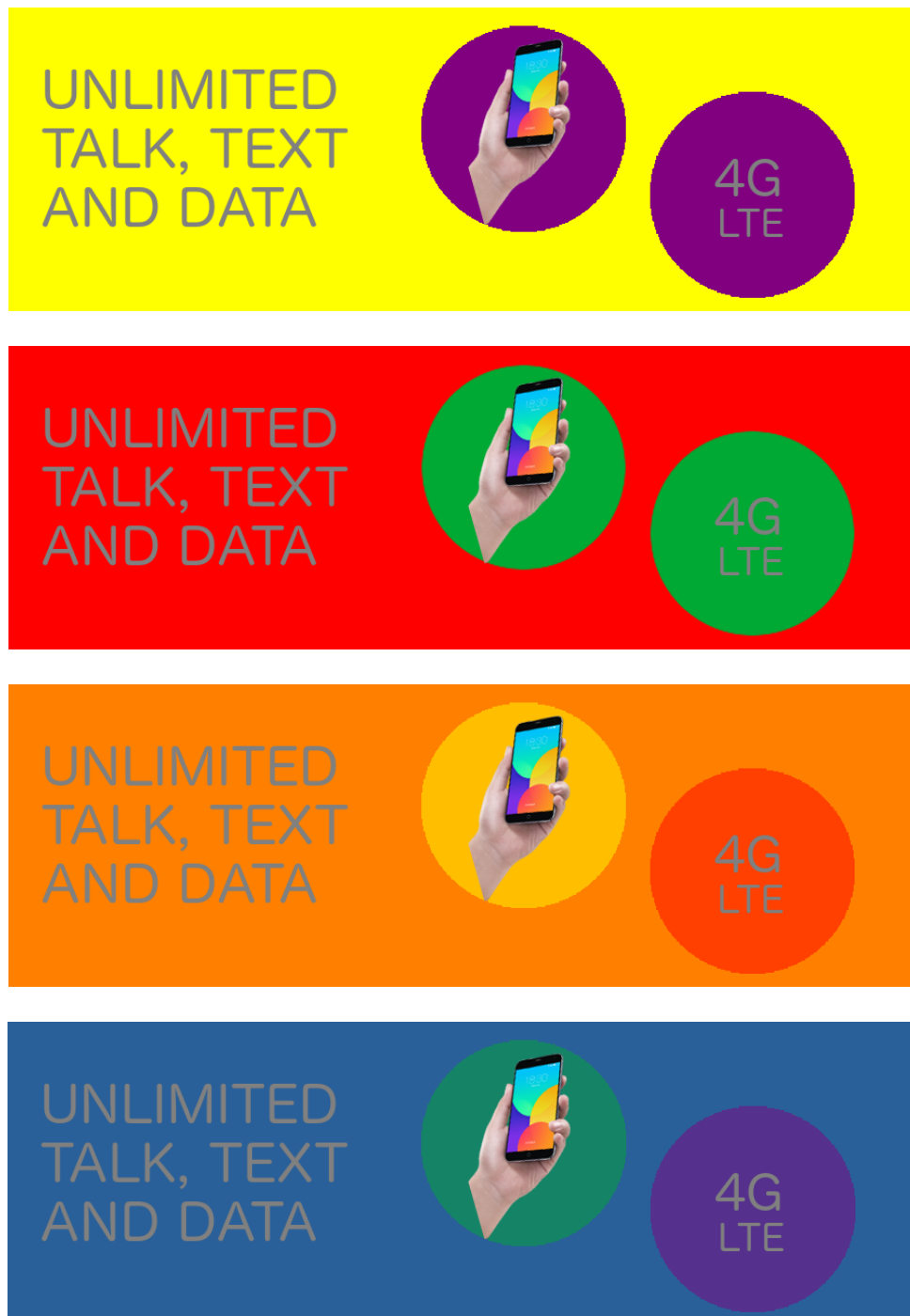
After completing the colorblindness test, participants were asked to imagine that they were in the market for a new wireless service provider and shown a series of web banner advertisements that were created using the software Gimp. The web banner advertisements (Figure 3) were advertising wireless cellphone service, since it is a highly familiar and widely used product. Each web banner had the exact same format and text but with different background colors. The background colors of each web banner corresponded to the colors used in Study 1. There was a yellow and violet complementary color web banner, a red and green complementary color web banner, a blue analogous color web banner, and an orange analogous color web banner. The text was written in gray, as gray is a neutral color. The phrasing of the web banner was chosen due to its consistency with other wireless service advertisements. After looking at each web banner ad, participants were asked to rate their attitude and purchase intention towards the product using two different 7-point bipolar scales. To rate their attitude towards the advertisement, participants were asked to rate if the ad was good/bad, pleasant/unpleasant, and favorable/unfavorable (McKenzie and Lutz 1989). To determine their purchase intention, participants were asked to rate if they would be likely/unlikely, possibly/impossibly, probably/improbably to purchase the product (Lutz et al 1983).

In total, 174 participants completed the survey. However, 12 were colorblind, and thus excluded from the sample. In regard to the sex makeup of participants, 42.9% were male and 56.6% were female. Once again, most participants had at least a bachelor's degree, with

33.7% holding a bachelor's degree, 33.1% holding a master's degree, 6.3% holding a PhD or other professional degree. Participants came from 42 different countries, with the majority being from the United States of America (24%), Estonia (18.3%), the United Kingdom (6.9%), and Portugal (5.7%). Participants ranged in age from 14 years old to 69 years old.

Figure 3 – Web Banner Advertisements

From top to bottom: yellow and violet complementary color set, red and green complementary color set, orange analogous color set, blue analogous color set



Results and Discussion

Similar to Study 1, to prepare the data for analysis all participants who did not complete the survey or answered 3 or more questions incorrectly during the colorblindness test were excluded from analysis. After making exclusions, we averaged the responses for each word pair corresponding to attitude towards the advertisement and each word pair corresponding to purchase intention. After these numbers were averaged for each participant, we used a one-way multivariate analysis of variance. The one-way MANOVA presented a significance level of .000 when $\alpha = .05$, meaning we can reject the null hypothesis that all colors cause participants to have the same attitude towards the advertisements and purchase intentions.

After conducting the one-way MANOVA, we ran a Tukey HSD post-hoc test to determine what the relationship was between colors and attitude towards advertisement and purchase intention. The Tukey HSD post-hoc test showed that the difference in attitude towards advertisement was only significant between the red and green complementary color set vs. the blue analogous color set ($p = .000$, mean difference = 1.7284), vs. the orange analogous color set ($p = .000$, mean difference = 1.3930), and vs. the yellow and violet complementary color set ($\text{sig} = .000$, mean difference = 1.8169). Since the color sets that had the highest levels of pleasure, arousal, and dominance (blue analogous color set), did not have the most positive attitudes toward the advertisement and highest purchase intention, we reject H4.

Similar to the difference in attitude towards advertisements between the different color sets, only the red and green complementary set had a significant difference to the other color sets in regards to purchase intention. The red and green complementary set had significantly higher levels of purchase intention vs. the blue analogous color set ($p = .000$, mean difference = 1.2510), vs. the orange analogous color set ($p = .000$, mean difference = 1.1440), and vs. the

yellow and violet complementary color set ($p = .000$, mean difference = 1.4). The red and green complementary color set had the most positive attitudes towards the advertisement and purchase intention, and all other color sets had no significant difference between them on either category. We reject H5.

Figure 4a -Estimated Marginal Means of Attitude Towards Advertisement for Each Color Set

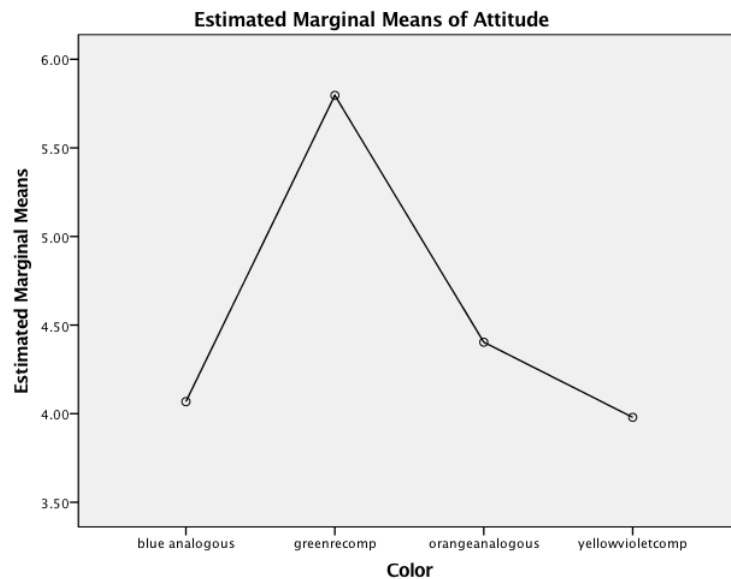
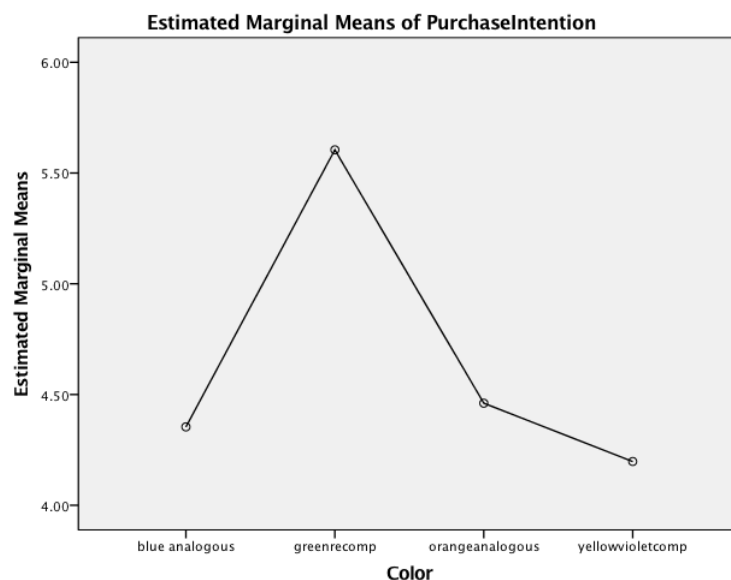


Figure 4b – Estimated Marginal Means of Purchase Intention for Each Color Set



The results of this study point to the fact that the red and green complementary color set had much higher levels of positive attitude towards the advertisement and higher purchase

intentions. Meanwhile, there was no significant difference between all the other colors overall regarding both variables of attitude towards advertisement and higher purchase intentions.

The result that the color set (green-red complementary) with the most positive attitudes towards the advertisement had the highest level of purchases intention supports the theory that attitude towards advertisement affects purchase intention (Lutz et. al 1983).

Furthermore, since the blue analogous color set did not have a significantly more positive mean in regard to attitude towards the advertisement and purchase intention, it contradicts the studies done by Biers and Richards (2005) and Babin et al. (2003) that found that cool tones elicited higher purchase intentions and more positive attitudes. One explanation for this could be that cool toned colors increase positive attitudes and purchase intentions in shopping environments (both online and in real life), but not in the case of online web banner advertisements.

General Discussion

In Study 1, we found that the red and green complementary color set had higher levels of pleasure than all other color sets and had significantly higher levels of positive attitudes towards the advertisement and purchase intention in Study 2. One possible explanation for the red and green color set having such high levels of pleasure, in addition to adults preferring the colors red and green is that many Americans perceive red and green as colors associated with Christmas (Tergwot and Hoeksma 1995). This association with Christmas, a holiday that is often associated with feelings of pleasure and happiness could cause the higher levels of pleasure in survey participants. Furthermore, Christmas is often associated with shopping, which could account for the higher purchase intention. Our findings that the color set with the most positive attitudes toward the advertisement had the highest level of purchase intention are also supported by Lutz et. al (1983), that found that attitude towards advertisement was a factor in purchase intention.

One surprising aspect of our findings was that pleasure seemed to be the only emotion that was correlated to more positive attitudes and higher purchase intentions, since the red and green complementary caused the most positive attitudes towards the advertisement and highest purchase intentions, while simultaneously evoking the highest levels of pleasure compared to all other color sets. The color sets with the highest levels of dominance and arousal did not have statistically different attitudes towards advertisement or purchase intention from one another. This finding is particularly important in regard to marketing advertising, as it shows that a pleasurable color alone, when all other factors are held constant (product, text, image) could have a profound effect on consumer's attitudes towards advertisement and their purchase intentions.

Limitations and Future Research

One of the limitations of the research study was that all the studies were done via online surveys. Online surveys, while good for attracting a diverse study sample of people from different ethnic backgrounds, can also cause problems with response bias, wherein respondents could feel pressure to respond a certain way. These response biases can exist in the form of acquiescence (responding to questions very positively no matter the content), satisficing (not exerting much effort to properly understand the questions or answer them), and over claiming (exaggerating or being afraid to choose the most extreme responses) (Sax et al. 2003). Another issue of online surveys, particularly when the survey is distributed through social media, is that the responses could come from a homogenous population, wherein the respondents could all be peers of the person distributing the survey. Since peers tend to be like-minded in beliefs, this could make the survey less diverse. Furthermore, with the use of online surveys, particularly anonymous ones, it's possible to have repeat respondents.

Another issue of our survey data was that while there were respondents from many different countries, the bulk of the respondents came from either the United States or Estonia (50.5% and 20.9% respectively in Study 1 and 24% and 18.3% respectively in Study 2). Having the bulk of the respondents coming from few countries is especially problematic in the context of this research because culture can play a factor in perception of colors. For example, green and red are usually associated with the Christmas holiday in the US, which could have affected the emotional responses, attitude towards the advertisements, and purchase intention in respondents.

The bulk of the respondents in both studies were on average very highly educated as well, with 73% of respondents in each study having obtained a bachelor's degree or higher. While educational attainment varies from country to country, only 33.4% of adults have a bachelor's degree or higher in the United States of America, suggesting that the respondents in our survey are not an accurate representation of the total population in regards to education levels.

One last limitation of the survey was regarding how the colors were perceived visually by participants. While we tried to screen participants for colorblindness through an Ishihara test, the abbreviated version we used was not the full Ishihara test for colorblindness, so it is possible that some participants with some form or degrees of color blindness were still able to respond to the survey. In addition, since the survey was taken online, participants could have gotten help from outside sources (such as getting the answers from a non-color deficient person in the room or researching the answers online) to answer the questions about the Ishihara plates accurately instead of how they perceived the plates. Lastly, the survey being distributed online instead of in a lab allows for no control over a lot of variables that could affect the perception of the color. Each participant could have taken the survey on a different computer screen with different brightness levels and resolutions. Furthermore, the ambient

lighting in each participant's room could have been different, which can change the way the color is perceived on the screen. If the survey was taken in a lab, all these variables could have been controlled to ensure more consistent and accurate color representation.

Since complementary colors are not very well understood or well researched in the field of consumer behavior, there are many opportunities for future research. Different pairs of complementary colors should be tested, such as blue and orange to see what emotional effect this color pair creates and in turn how they affect attitude and purchase intention. More research could also be done on complementary colors from the RGB color wheel, as this is a very popular color wheel used in most editing software. In addition to exploring how different sets of complementary colors affect the dimensions of emotional affect, attitude towards advertisement, and purchase intention, there is opportunity to study the effect of complementary colors in other dimensions related to consumer behavior. For example, complementary colors could be studied in the context of brand perception and attitude towards brand, since these are factors that can also influence individuals' purchase intentions.

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